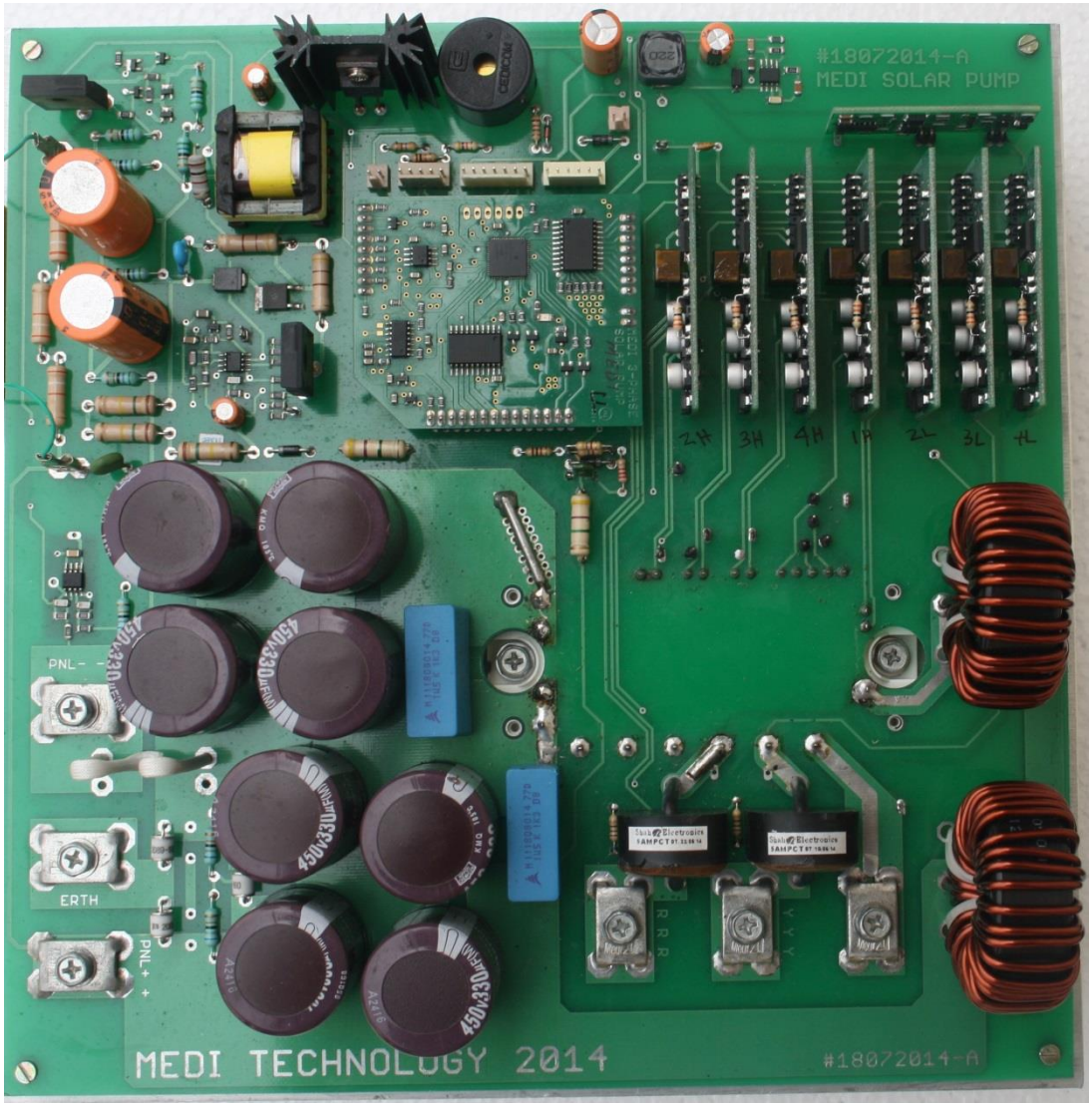
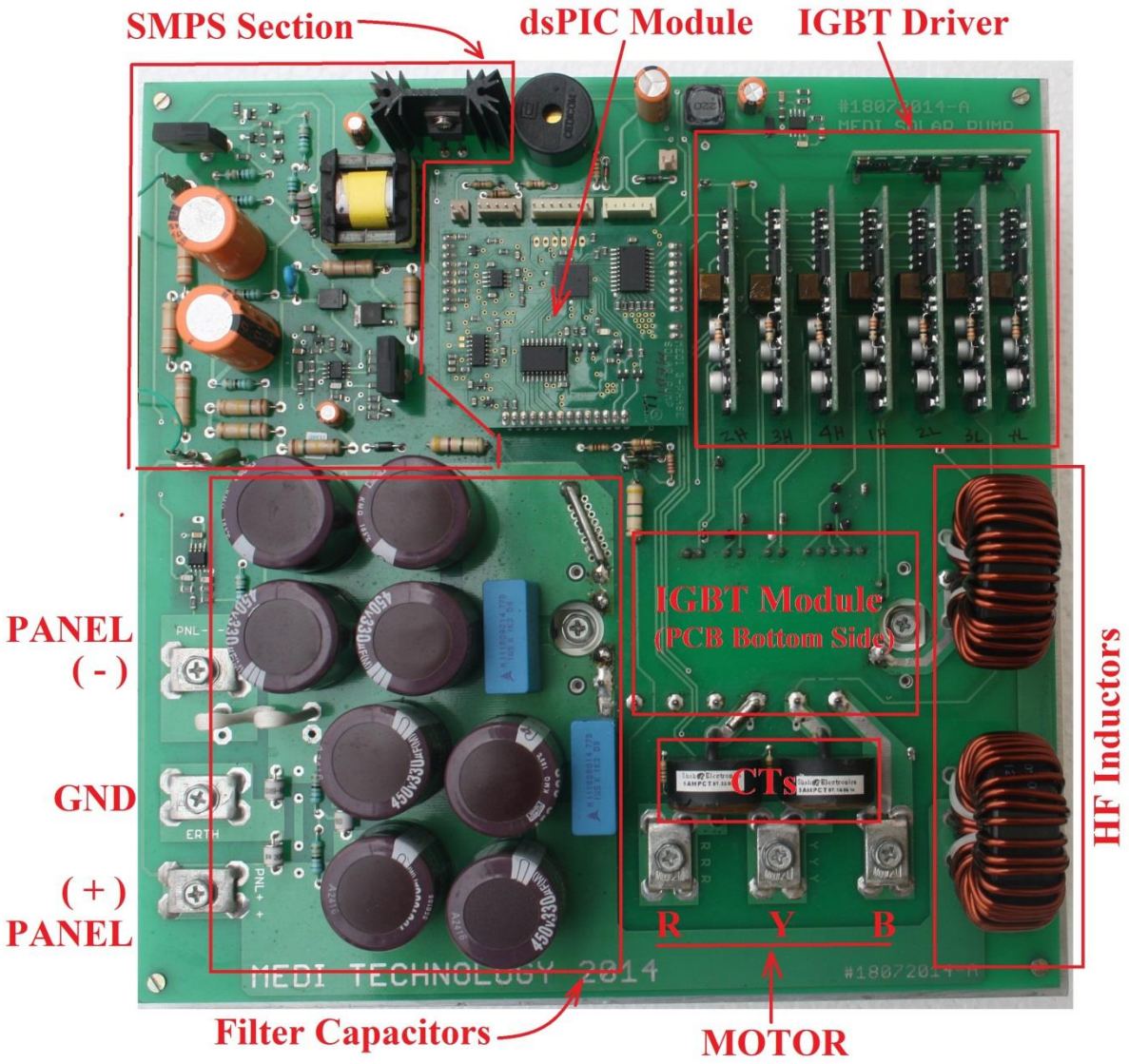
MEDI’s transformer-less solar pump control with MPPT and VFD - 1HP to 5HP

MEDI has announced the release of its new design of solar pump control with inbuilt MPPT and VFD which is targeted towards low power use. The design is best suited for applications up to 5HP. The main attractions of this new design are it is low cost & extremely simple to assemble because DSP control stage and power stage and heat sink are on a single PCB.

The DSP control module does most of the job which makes the rest of the PCB very simple and leaves few components to be assembled on the main PCB. The complete control stage, SMPS, IGBT module along with heat sink are all in a single PCB which makes it easy to manufacture.

The photo below shows the complete assembled low power solar pump control for 5HP




SMPS Section
dsPIC Module
IGBT Driver
PANEL
(-)
GND
(+)
PANEL
IGBT Module
(PCB Bottom Side)
CTs
R
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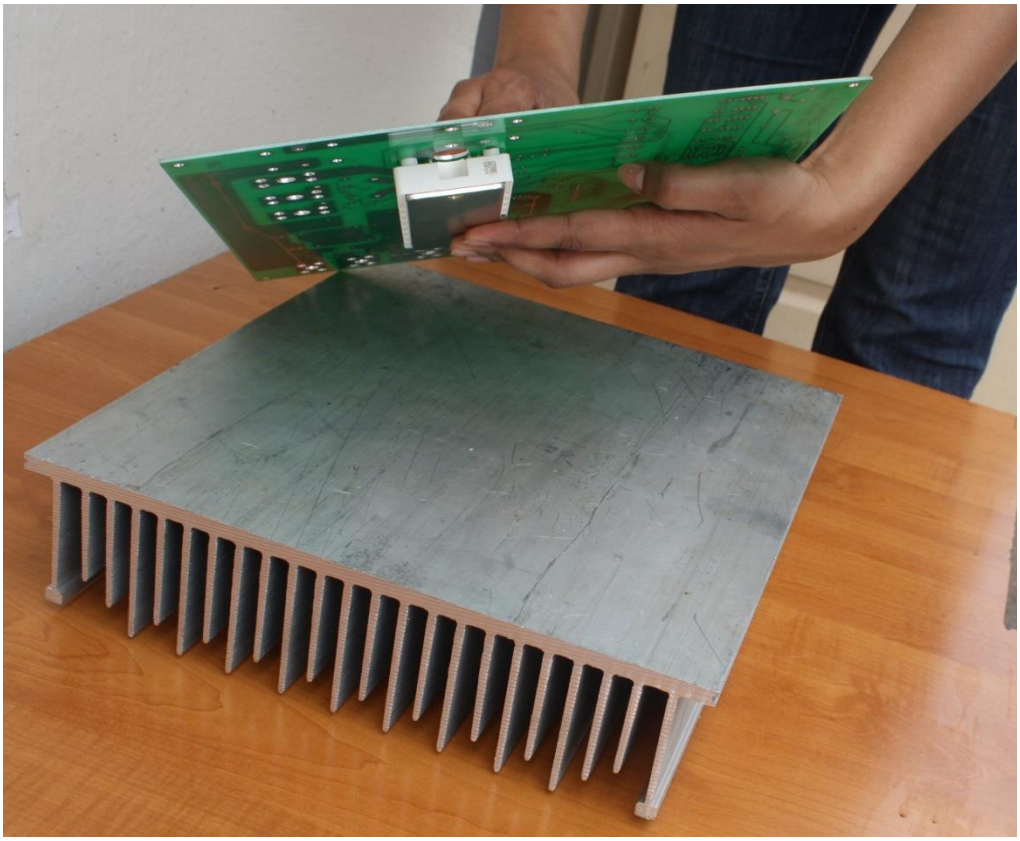
B
HF Inductors
Filter Capacitors
MOTOR



The IGBT can be mounted on the PCB directly and …

Then fixed on the heat sink.

The top cover can be fixed on the heatsink. The display and switch will be on the top cover.

FEATURES –

>This solar inverter with MPPT VF drive will give maximum torque even at minimum sunlight

> There is no need of any battery, directly connect the panel to the inverter and the output of the inverter can be connected to a three phase motor.

> The DSP will track at which point the maximum power can be extracted from the panel by varying the PWM and modulation frequency so the motor will run always extracting the maximum power from the panel and at a constant torque for the wide range of intensity of sunlight - morning till evening.

> This will give 35% extra energy which results in pumping 35% more water compared with the conventional three phase inverter +MPPT & three phase pump or DC motor based pump.

SPECIFICATION –

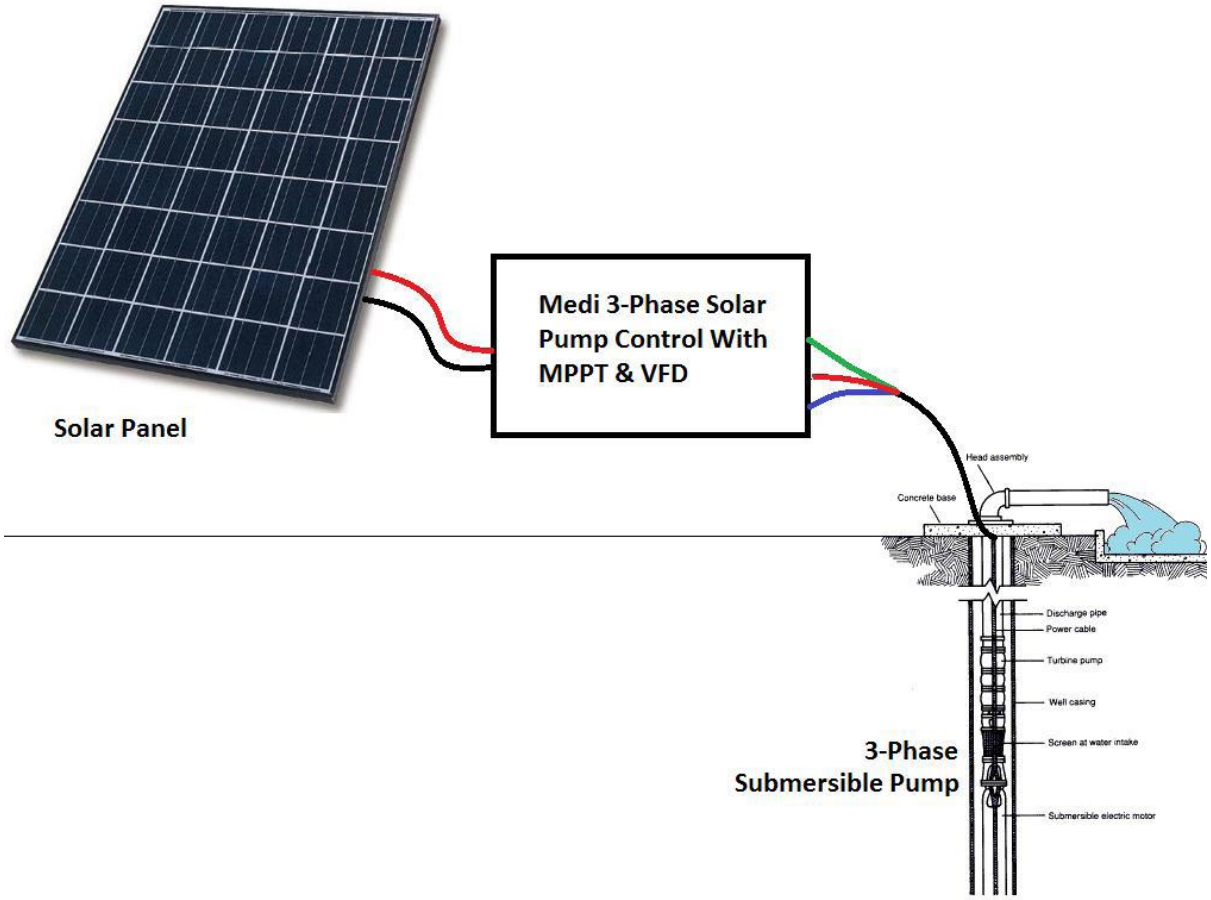
Panel voltage range : 60V to 850V

Wattage : 0 to 5HP

AC output voltage : 0 to 480V phase to phase

Output frequency : 0 to 65Hz

1. DSP based intelligent Maximum Power Point Tracking (MPPT) will give 35% more energy from the panel.
2. Because of the variable frequency drive (VF drive) the starting current of the motor will come down drastically. So the motor will start even at minimum intensity sunlight - say morning 7 o'clock.
3. VF drive will give constant torque for wide range of intensity of sunlight - morning till evening. So water will be continuously pumped from morning till evening
4. PWM frequency - 4KHz & 20KHz (settable)
5. Wide range of operating voltage
6. Pure sine wave three phase current to motor
7. Wireless zigbee communication



MPPT action - Maximum Power Point Tracking

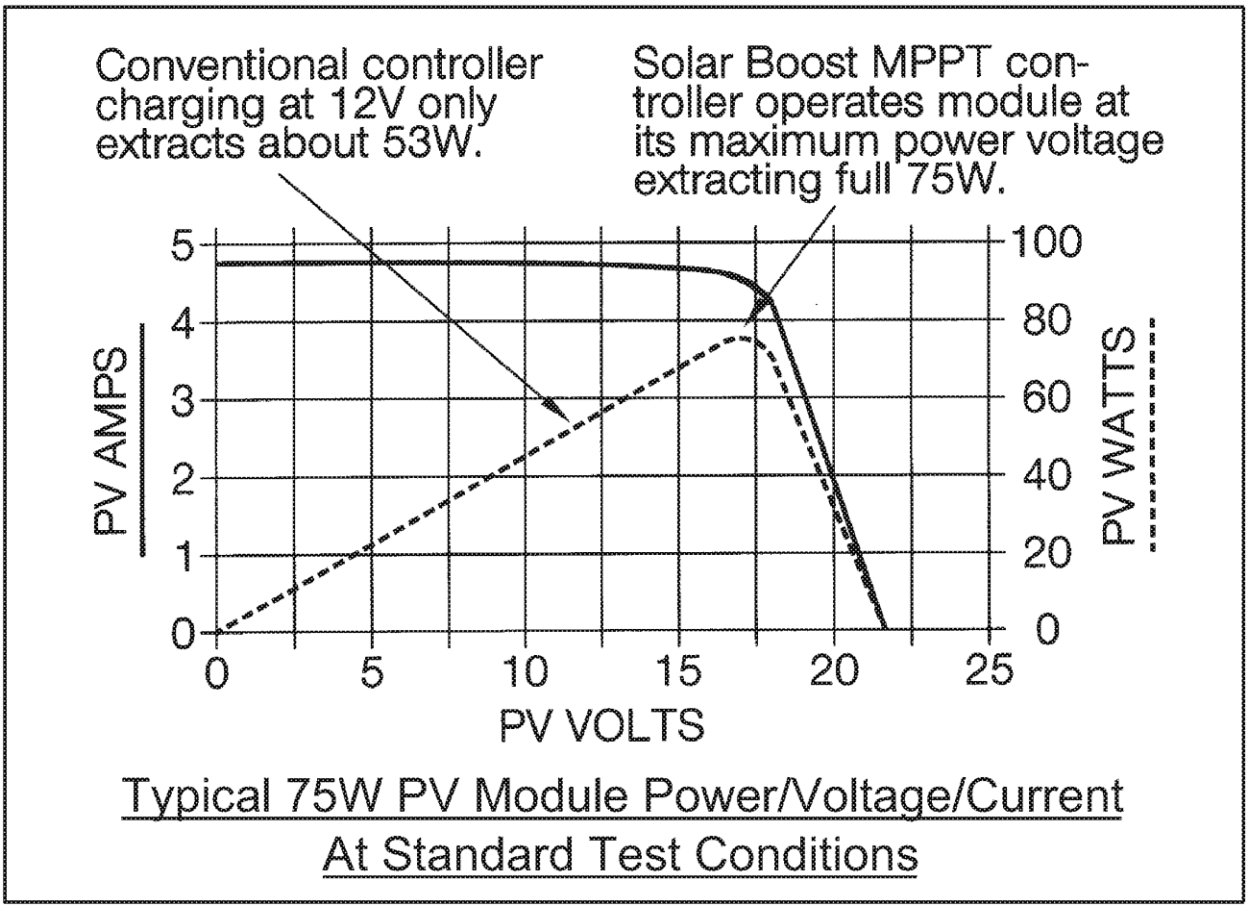
If a DC motor is used along with the pump there is no MPPT action. If the motor is designed to work at maximum power point during peak sunlight (noon) then at less intensity sunlight (mornings and evenings) the motor will not be at its maximum power point so the full energy is wasted. On the other hand if the motor is designed for maximum power point during less intensity sunlight, it will not be at its maximum power point during noon which again leads to waste of energy. Even though this method is used in many places it is in-efficient.
This system works at its best during any time of the day at any kind of sunlight so effectively we will get 35% extra energy which is being wasted at present using other inefficient methods.

For example –
If the system is drawing 10A from the panel and if the panel voltage drops to 600V, then we get 6000W.
If we are drawing 12A, the panel voltage drops to 498V, then we get 5980W.
If we are drawing 9A, the panel voltage will be 665V, then we get 5990W.

So the maximum wattage was obtained when we are drawing 10A.

At various conditions of temperature, sunlight intensity etc the maximum power point will vary so we may also get maximum power at 9A or 11A or some other.

Our unit will convert the panel voltage directly to three phase and vary the PWM for varying the panel current and the DSP will calculate at what current the maximum power can be extracted from the panel, this point will be tracked constantly. As and when this point varies the unit will follow and re-track this point at all sunlight intensities and weather conditions. This way, we have now obtained the maximum power from the panel.



Typical 75W PV Module Power/Voltage/Current
At Standard Test Conditions

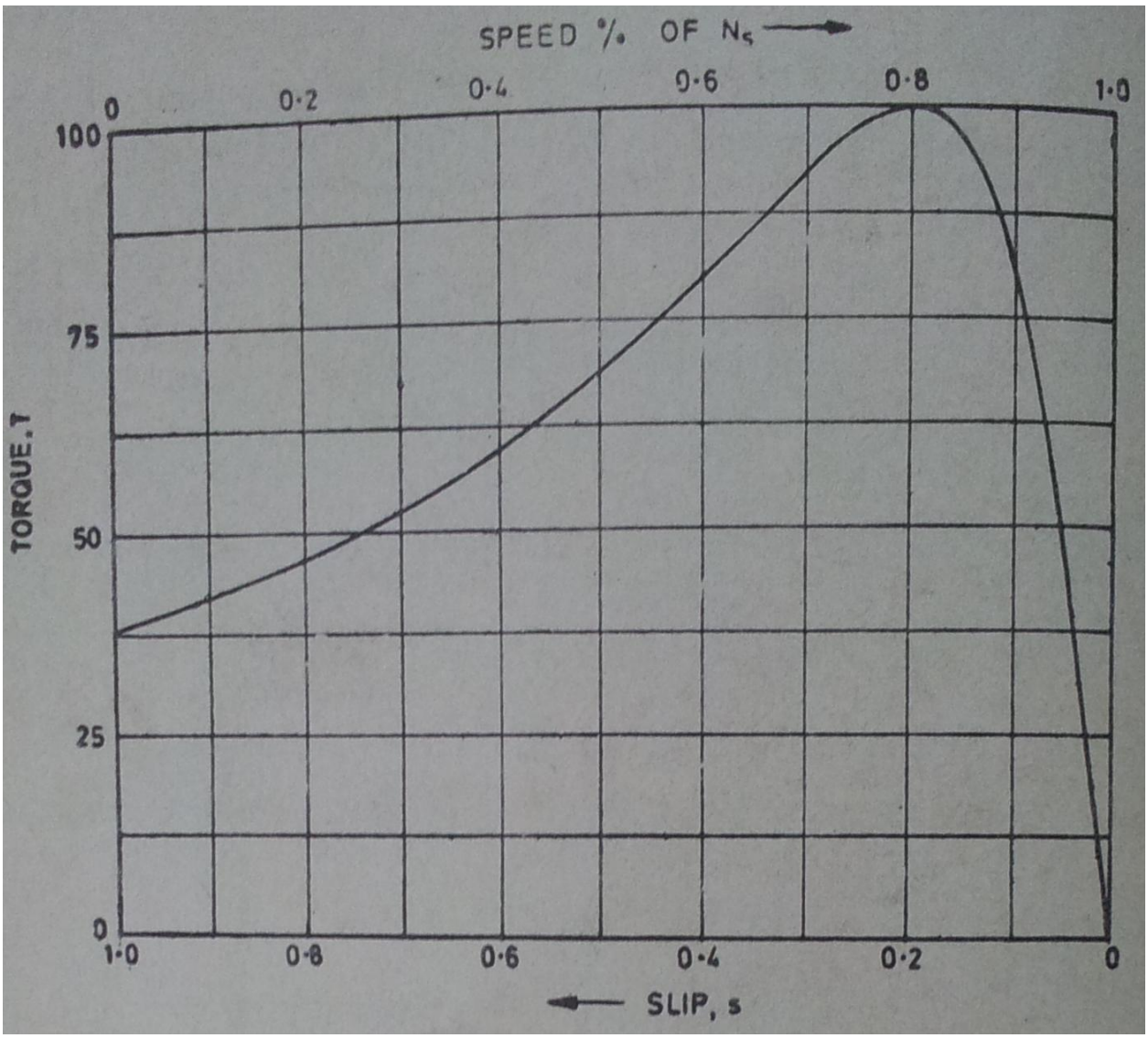
Variable frequency drive eliminates the high starting current of the induction motor

The induction motor has very high starting current which is around eight times of the running current of the motor. If the motor is started with load, the starting current is much higher than this. Without smooth start high wattage panels are required for starting the motors. Because of the smooth start using variable frequency, the motor will start as early as even 6am without taking any starting current. It is practically observed that the starting current will be lesser than the running current from the panel.

Maintaining maximum efficiency of the induction motor by varying VF ratio

The induction motor has maximum efficiency at certain VF ratio. By simply increasing the voltage or the frequency we are reducing the efficiency. If we increase the voltage the slip will reduce so the efficiency and torque will reduce. If we increase the frequency the slip will increase so the efficiency and torque will again reduce. The induction motor has maximum efficiency at a certain slip.

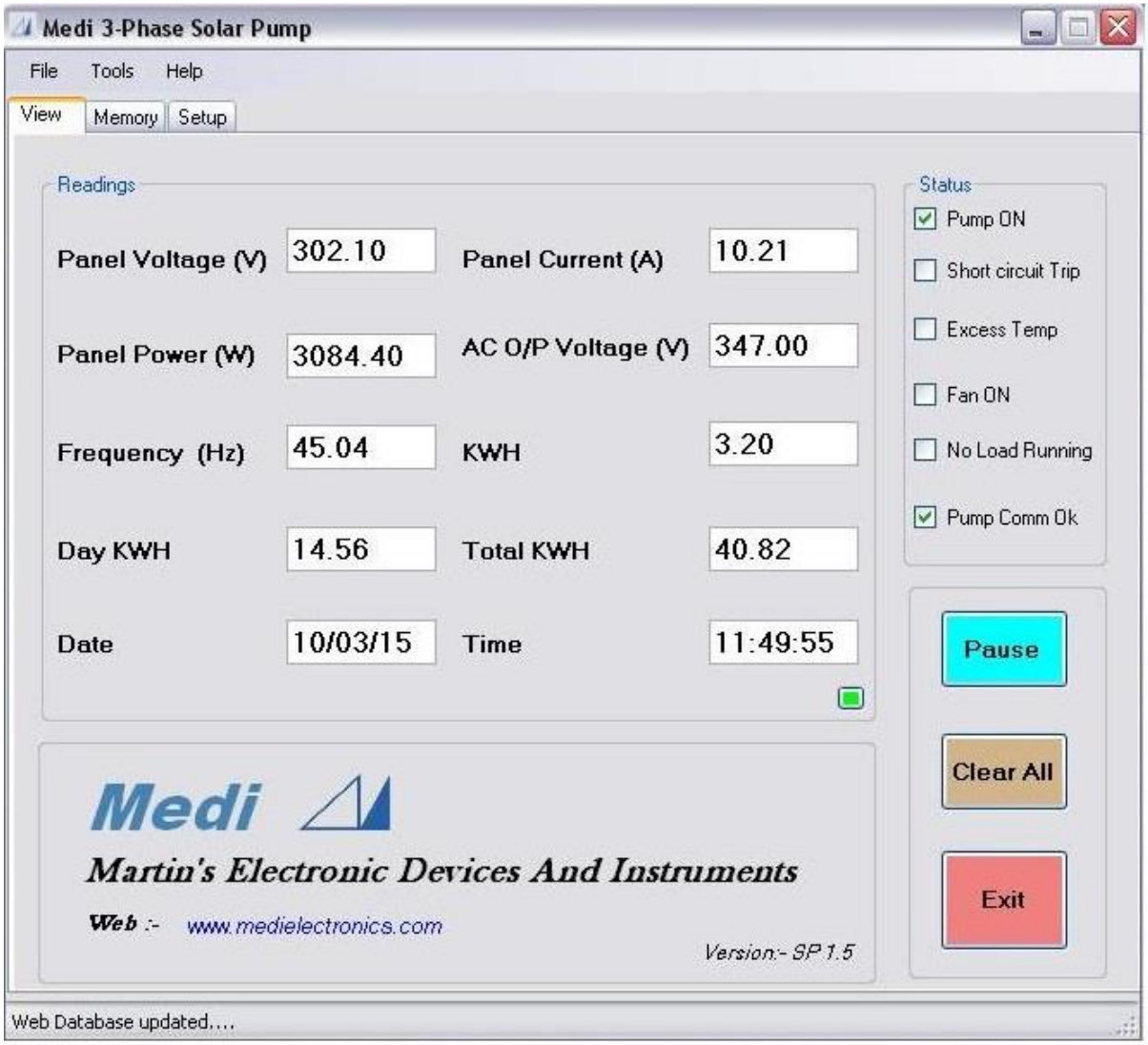
The graph below explains –



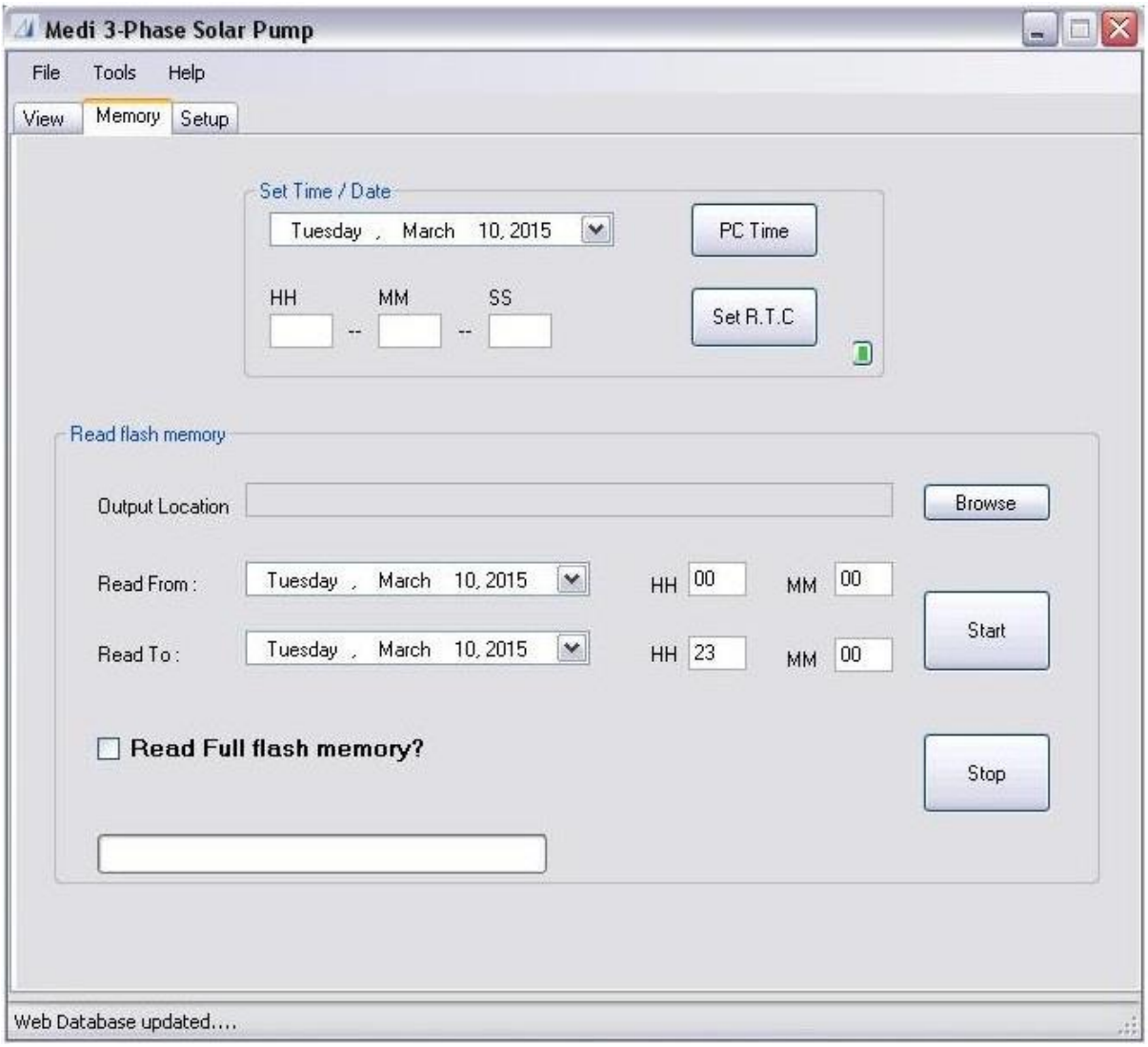
The system runs at maximum efficiency at all the time by constantly maintaining the motor in the right slip which leads to this maximum efficiency.

Wireless Zig-bee Communication

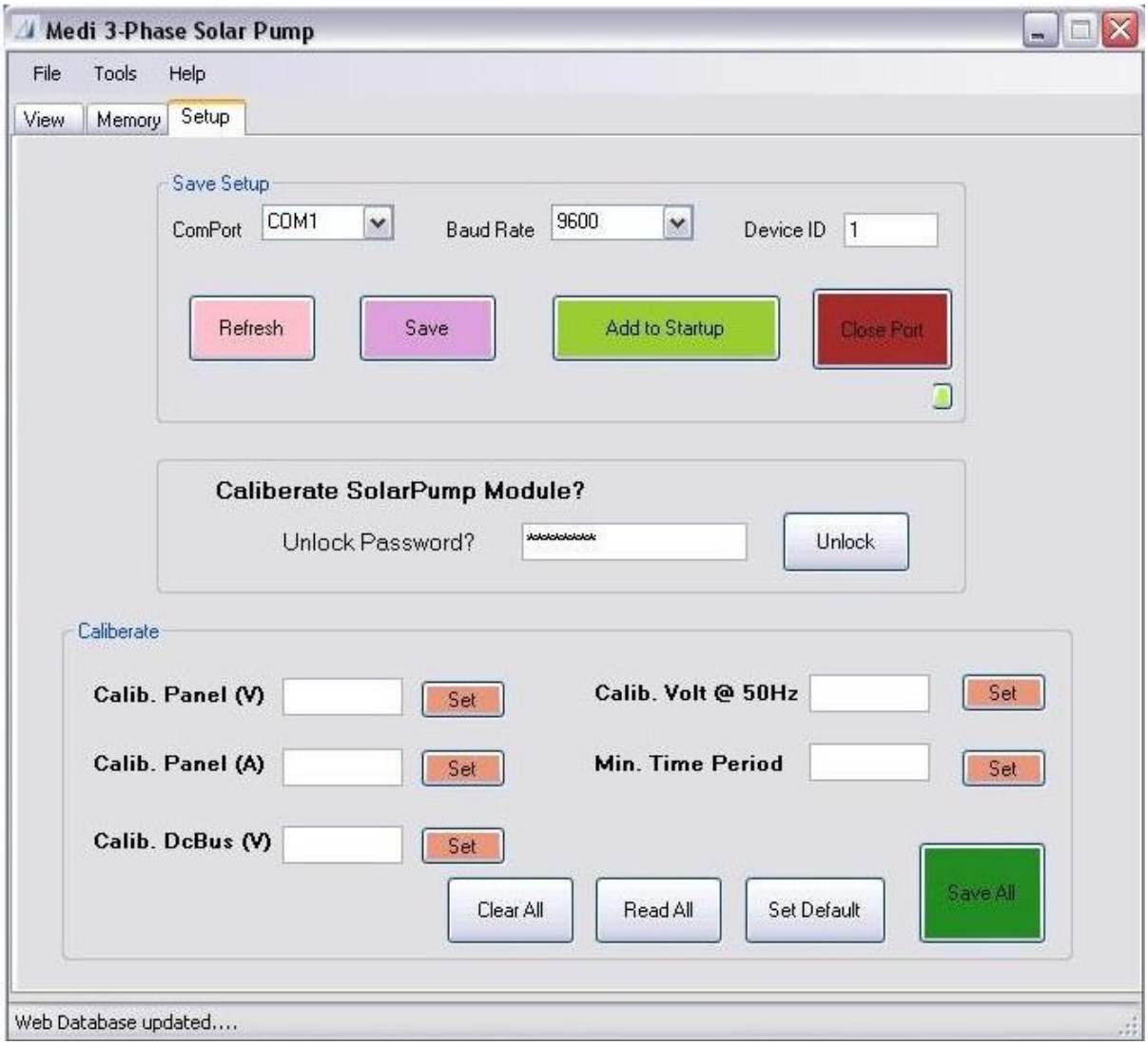
Wireless communication feature to interface solar pump unit with computer



All parameters like panel voltage, panel current, output voltage etc can be monitored in the computer using wireless zig-bee communication



Interface for date, time setup as well as reading the stored data from the datalogger. The date and time can be set up in the computer and fed to the unit through wireless communication.



All values such as panel current, panel voltage, frequency etc can be calibrated in the computer and uploaded to the unit through wireless communication

Technical know-how cost of MEDI's transformer-less solar pump control with MPPT and VFD 1HP to 5HP - Rs.10,00,000

Cost of MEDI's control module – Rs.5500

The cost of control module is fixed for the entire range up to 5HP.

Approximate BOM of a 5HP unit is Rs.15000 including MEDI's control module.

Technical know-how for 7.5HP and 10HP is transferred free of cost along with this design.